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Canadian Journal of
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VOLUME 46 TORONTO, JULY 1955 NUMBER 7

Preparation of Poliomyelitis Virus for Production of Vaccine for the 1954 Field Trial†

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F. T. SHIMADA, AND D. G. GRAHAM
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THE important demonstration of Enders, Weller and Robbins (3) that viruses of poliomyelitis proliferate in cultures of human embryonic tissue opened wide areas for study of the cause and prevention of this disease. When Rhodes and his associates showed (5) that the entirely synthetic nutrient Medium no. 199 devised by Morgan, Morton and Parker (6) can replace conventional tissue culture media containing antigenic material such as horse serum, a cell-free vaccine suitable for use in children became a possibility. Salk and his colleagues in fact used Medium no. 199 in tissue cultures to prepare their experimental formol-vaccine for inoculation of human subjects (7). The results of experiments on quantity production of poliomyelitis viruses in cultures of monkey kidney were reported by Farrell et al. in 1953 (4). The two techniques described were an enlargement or development of those used by Enders and his colleagues, the "roller tube" and "suspended cell" techniques.

In our experiments the "suspended cell" technique was developed by continuously rocking Povitsky diphtheria toxin bottles containing infected fragments of monkey kidney in 500 ml. synthetic Medium no. 199. This method gave titres of virus greater than 10^{-6} in monkey testicular fibroblasts and was distinctly simpler than the cumbersome 4 litre or 20 litre rotated bottle cultures of monkey kidney epithelium which were our enlarged "roller tubes". The high titres, the absence of horse serum or other naturally occurring complex ingredients in the medium and the practicability of this "rocked culture" technique opened the way for production of the quantities of these

Aided by a Grant from the National Foundation for Infantile Paralysis Inc.
†Conducted by the National Foundation for Infantile Paralysis, New York.

fluids necessary for a large field trial of an experimental vaccine such as that used by Salk.

In June 1953 the National Foundation for Infantile Paralysis, New York asked the Laboratories to prepare 420 litres of such fluids, balanced as to immunological Type for use in the preparation of vaccine for a field trial. This possibility required consideration of the safeguards necessary for material intended ultimately for use in children. In consultation with Dr. A. J. Rhodes, the first outline of requirements was drawn up and submitted to the National Institutes of Health. These included the standard sterility tests of the N.I.H. as well as special tests considered necessary for protection against infections likely to come from the monkeys, particularly those caused by *M. tuberculosis* and Virus B. In August, the original request for 420 litres of fluids was increased to regular shipments of 186 litres every fortnight until 2,000 litres had been supplied. Before plans were complete for this program, the requirement was increased to a minimum of 200 litres a week, with subsequent preparation of 320 litres a week at the peak.

When this program was in progress, Dr. Salk made available to us early observations on the technique of monolayer tissue cultures (1) adapted in his laboratories to roller tube titration and bulk production of virus (8). The technique of titration was adopted at once with certain modification. Experimentally, we confirmed that the titre of virus in bulk production was as high as that attained with our technique, but the increase in labour nearly offset the saving in monkeys. Moreover, the momentum of the program was such that about half the volume would have been prepared by our method before such a major change could be introduced and it appeared wiser for us to supply fluids which were as nearly uniform as possible throughout.

The present report describes the materials and technique used for production of 5,521 litres of tissue culture fluids containing virus of poliomyelitis, and the tests made for sterility, potency, immunological type, toxicity and presence of other viruses in these fluids. It summarizes experiences encountered in this large program and includes the results of tests and the yields of fluids deemed suitable for inactivation in terms of the arbitrary standards set up. This provides an outline of the background of the 3,300 litres of virus fluids used in preparing most of the vaccine used in the 1954 field trial.

Washing and Cleansing of Glassware

All glassware used in the preparation of tissue cultures was boiled with "Alconox", thoroughly rinsed and brushed mechanically and immersed in concentrated sulphuric acid containing 0.5 percent sodium nitrate and sodium chlorate. In our first experiments and in the beginning of this program, thorough rinsing with tap water and double-distilled water was followed by a rinse in ion-exchanged water. With the quality of double-distilled water available to us this last rinse proved unnecessary and was omitted. New glassware and glassware used only for preparation or holding Medium no. 199 was treated with 1 percent hydrochloric acid for four hours and then thoroughly rinsed.

Medium

Synthetic Medium no. 199 prepared in Earle's solution to which was added 500 units/ml. penicillin and 250 mcg./ml. streptomycin was used exclusively in this program. This medium was used without any addition for tissue culture of monkey kidney for bulk production of virus. For preparation of roller tubes, 0.5 percent horse serum was added to obtain the initial outgrowth of kidney epithelium, but this medium was replaced with entirely synthetic solution for purposes of test.

Monkeys

Weekly shipments of Cynomolgus or Rhesus monkeys, usually 280, were received from the National Foundation for Infantile Paralysis. They were tagged and tested with Old Tuberculin. Positive reactors were destroyed at once and the negative animals used within two weeks. On day of operation, animals were anaesthetized with Butylone and taken to the operating room. For operation, the anterior approach was used and the renal vessels clamped off immediately before removal of kidneys. Kidneys from each monkey were placed in a separate sterile container with sufficient Medium no. 199 to cover them, and kept on ice until 6 or 8 animals were operated on. Each animal was examined for gross signs of disease and the results of autopsy reported on a form. Any animal showing gross pathological lesions was discarded together with the kidneys. Lung, spleen and bronchial and retroperitoneal lymph nodes were submitted for histological examination from the first 400 monkeys used. This procedure gave no evidence of tuberculosis in animals otherwise passed as free from infection and was thereupon discontinued.

Finely chopped monkey kidney tissue is placed in culture bottles.

National Film Board

Bottles containing tissue cultures are continuously rocked during incubation.

Tissue

A pair of kidneys was transferred aseptically to a sterile Petri dish marked with the animal's number, and the capsule removed. Each kidney was split longitudinally, examined for abnormalities and discarded if not normal. Normal tissue was transferred to centrifuge tubes marked with the culture number.

As a routine, weight was estimated by volume of whole kidney and about 1 percent kidney (5 to 8 gms.) used for each bottle. In the majority of instances this required one and one-half kidneys, occasionally only one and rarely two. The culture number and the corresponding animal's number were recorded on a form. The portions were washed 3 times with Medium no. 199, and chopped with scissors until the fragments were 1 mm. or less in diameter. Tissue was washed with Medium no. 199 at least 3 times in the course of chopping.

About 20 fragments of kidney from each of the first 420 monkeys were washed with 5 ml. of modified Dubos medium, distributed over 2 slopes of Loewenstein's medium and incubated for 4 weeks to test for presence of tubercle bacilli. When this procedure led to entirely negative results it was discontinued.

Culture Bottles

As in the experimental work 5 litre Povitsky bottles were used. They were equipped with rubber stoppers carrying a short 18 mm. tube for addition of chopped tissue and a siphon for removing the supernatant fluid after incubation of the cultures. This siphon was bent so that only as the bottle was turned to draw off the fluid was the tip in contact with the medium. The end of the siphon was covered with a cotton gauze filter to prevent withdrawal of tissue fragments. It may be emphasized again, that only hard glass is suitable for tissue culture work. Experimentally, contact of Medium no. 199 with soft glass tubing for half an hour reduced the subsequent titre of virus from 6.5 to 5.7. Sterilization of empty culture bottles with indwelling siphons made of soft glass reduced the titre to less than 5.

About 500 ml. culture medium was added to the bottles aseptically and the openings sealed with rubber stoppers or solid glass rod to prevent escape of carbon dioxide. Chopped tissue was added aseptically. Gas from cylinders containing 5 percent carbon dioxide, 16 percent oxygen, 79 percent nitrogen was passed into the atmosphere above the medium for 2 minutes at a rate of 5 litres per minute, to prevent rise in pH of the medium.

Incubation of Culture Bottles

The culture bottles were incubated at 37°C. for 6 days on rocking machines similar to the one previously described, and then brought back to the laboratory. They were inspected for gross evidence of contamination and comparison of pH with standard solutions. Any bottle suspected of being contaminated or with pH differing significantly from others of the batch was discarded. Most of the supernatant fluid from 6 or 8 cultures was drawn off into a 4 litre bottle and the combined fluids tested for bacteriological sterility. The exhausted medium was replaced with 750 ml. fresh Medium no. 199. Each bottle was infected with 2 ml. of seed virus of the required Type and returned to the

rocking machine. After 4 or 5 days' incubation, each bottle was inspected as above, and tests for sterility of the preinfection pools read for assistance in finding possible contamination.

Virus Inoculum

Mahoney (Type 1), M.E.F.1 (Type 2) and Saukett (Type 3) strains were used in the form of tissue culture fluids derived from stock supplied by Dr. J. E. Salk. Strain M.E.F.1 was used in the third, fourth and fifth subculture after receipt in our laboratory; the Mahoney and Saukett strains were used as the fourth, fifth and sixth subculture.

Pooling of Culture Fluids

The supernatant fluid from 10 or 12 normal virus infected cultures was collected in a ten litre bottle, chilled in crushed ice. This bottle was agitated to ensure uniformity. Five samples of 50 ml. and 2 of 25 ml. were taken from each large pool of virus for titration and typing of virus, tests for bacteriological sterility and presence of other viruses and for standard toxicity tests.

Storage of Virus Pools and Samples

In the first twenty-four experiments (56 pools) the uniform fluid was distributed at once into chilled blood bottles of 650 ml. capacity, 400 ml. being put into each. The bottles were sloped in a deep freezer at −30°C. and stored frozen. When Dr. J. E. Salk informed us that fluids were stable at 0°–4°C., the 10 litre bottles were held at that temperature until used for processing. Two 50 ml. samples for reference and the samples for test of toxicity were stored at −30°C. The samples for sterility testing were held at 0° to 4°C., until tests were complete.

Tests for Bacteriological Sterility

Samples from the first fifteen experiments were inactivated with penicillinase and tested for sterility by the usual test prescribed by the National Institute of Health. In this test only 1 tube containing 0.25 ml. of the material undergoing test is incubated at room temperature and experience suggested that light contamination with yeast or mold might be rather easily missed. Subsequent pools were therefore tested in duplicate at 37°C. and room temperature in the following way. Two samples (11 ml.) of the virus pool were added respectively to 1 ml. of penicillinase and incubated for 1 hour at 37°C. The contents of each tube was then distributed as follows: 1 ml. to tube containing tryptic digest of casein broth; 1 ml. to tube containing meat mash broth; 1/4 ml. to tube of thioglycolate broth; 4 ml. and 5 ml. to two flasks of casein digest broth. One set was incubated at 26°C., the other at 37°C. Final readings on all were made in 7 days and the results recorded on a special form. If any container gave indication of contamination, two additional complete tests giving entirely negative results were required to clear the pool of suspicion.

Identity Test on Virus Pool

The identity test consisted of the specific antibody-virus neutralization test in roller tube cultures. Virus at a dilution of 10^{-2} was added to 1:2 dilutions

of (a) normal monkey serum, (b) Brunhilde (Type 1) immune monkey serum, (c) Lansing (Type 2) immune monkey serum and (d) Leon (Type 3) immune monkey serum and incubated for one and one-half hours at room temperature. Groups of 5 roller tube cultures (usually monkey testicular fibroblasts) were inoculated respectively with the above mixtures and a group of 5 uninoculated cultures kept as controls on the condition of the tissue culture cells. Final reading of cytopathogenic changes was made after 7 days' incubation.

Toxicity Test on Virus Pool

This test consisted of the intraperitoneal injection of 2 mice (20 gm. weight) with 0.5 ml. virus pool and 2 guinea pigs (350 gm. weight) with 5 ml. Animals were observed for 7 days. Pools were released if all test animals showed negative results.

Technique of Virus Assay

Virus content of the first pools was titrated by inoculating serial dilutions into roller tube cultures of fragments of monkey testicular or kidney tissue prepared with a plasma clot. Subsequent pools were titrated in roller tube cultures of monkey kidney tissue treated with trypsin according to the method described by Dulbecco (2), and modified by Youngner (9). In our experiments 0.2 ml. of serial tenfold dilutions of the virus pool made in Medium no. 199 were added to groups of 5 cultures, and 1.8 ml. of no. 199 added. Cultures were incubated in a rotating drum at 37°C. They were examined at 4 and 7 days and endpoints calculated by Kärber's method on the 7 day readings. Titres were expressed as the dilution of virus causing cytopathogenic changes in half the inoculated cultures (CPD_{50}).

Tests in Rabbits for Presence of Virus B

Two rabbits were inoculated, both by the intracerebral route (0.25 ml.) and by corneal scarification (0.1 ml.). The animals were observed for 2 weeks and examined daily for signs of infection. If sickness or keratitis developed, the animal was killed and portions of brain, spinal cord and cornea were removed, fixed in formalin and submitted for histological examination.

Results

Monkeys

Of 7,055 monkeys received during this program, 28 were found to have tuberculosis, either when tested with Old Tuberculin or at autopsy. Another 37 were rejected at autopsy because of other disease. Of 6,516 apparently healthy animals, the kidneys from 416 showed abnormalities and were discarded. Further examination of these discarded kidneys showed that the "abnormalities" were frequently adrenal rests and many of these organs could properly have been used. Nevertheless, the decision was maintained to use only apparently perfect tissue throughout.

Bacteriological Sterility

A total of 8,884 tissue cultures were prepared for production. Of these, 304 showed gross evidence of contamination and were discarded at once. Virus

fluid from the others was collected in 851 pools, 3 or 4 pools of 7 to 8 litres each being prepared at each harvest, or a total of 5,520 litres. When the rigorous sterility tests described above were applied to these pools, 102 (12 percent) were positive, or a total of 601 litres (10.8 percent). Of this volume 41 percent was contaminated with yeast, 29 percent with mold and 30 percent with various kinds of bacteria, most commonly bacilli. Sources of contamination were not definitely determined. Of the 102 contaminated pools, 45 were made up of the majority of bottles comprising a single day's harvest and the contaminant was common to the group of 2 to 4 pools. Occasionally, close inspection revealed a small colony in otherwise apparently sterile medium which had been stored. Presumably such late growth would be overlooked at times. Spot checks on the kidneys at intervals showed contamination in 1 percent to up to 25 percent of the organs, usually due to Gram negative bacilli. Doubtless in some instances forms resistant to the antibiotics developed in the tissue cultures.

Titre of Virus Fluids

When this program was instituted, little information existed concerning any relationship between titre of virus fluids and antibody response to formol-vaccines prepared from them. We found previously (4) that titres of $10^{-5.5}$ to $10^{-6.0}$ tested in fragments of monkey testes or kidney were reached rather regularly. We arbitrarily decided that to be acceptable a fluid must have a titer of $10^{-5.3}$ in testicular fibroblasts and/or a titre of $10^{-5.8}$ in kidney epithelium. When we used assay tubes prepared from kidneys treated with trypsin, we found that the titres we obtained were about 1 log higher than in assay tubes prepared by the earlier technique. Again arbitrarily, we therefore set as the lower limit, a titre of $10^{-6.5}$. In practice, titrations were usually repeated only if the titre was less than this figure, and fluids were rejected as of low potency only if a second titration showed that the fluid had in fact, a titre below this arbitrary figure. Of 1,745 litres of Mahoney (Type 1) fluid, only 13 litres failed to meet this standard. This low potency material was not contaminated. Of 1,849 litres of M.E.F.1 (Type 2) fluid, 91 litres (5 percent) failed to meet the standard; of this, 38 percent was contaminated as compared with an over-all rate of contamination for M.E.F.1 of 13 percent. Nevertheless, of the contaminated M.E.F.1 fluids, (244 litres) more than 80 percent (209 litres) had a titre of 6.5 or better. The failures among the Saukett (Type 3) fluids were somewhat more numerous: 139 litres out of a total of 1,750 or 8 percent. Of this, 41 litres were contaminated or 30 percent. This compares with the relatively low rate of contamination for all Saukett fluids of 6.5 percent. Again, this would suggest that contamination may be related to lower titre, although 60 percent of contaminated Saukett fluids did have a satisfactory titre.

Other Viruses

Eleven pools (76 litres) were rejected as viruses other than those of poliomyelitis were also found in the tissue culture fluids. The virus in seven of these was identified as Virus B, and observations on six pools have been

reported in detail by Wood and Shimada (10). Viruses from the other four pools presumably are of monkey origin also, but have not been identified. All were observed in tissue culture and isolated, but only Virus B appears pathogenic for the animals tested.

Toxicity Tests

All seven pools of virus fluid from which Virus B was isolated in tissue culture caused typical reactions and death of rabbits. Only one other pool failed to pass the toxicity tests. This lot was contaminated with Gram negative rods and killed rabbits and mice, though irregularly.

Satisfactory Virus Fluids

Of 5,521 litres of virus fluids prepared, 4,450 litres, or more than 80 percent met all our arbitrary standards. Of this satisfactory material, 3,280 litres balanced as to Type were shipped for filtration and inactivation for the 1954 field trial of vaccine. A preliminary report on laboratory tests of antibody response to vaccine made from these fluids appeared recently (8). This report indicates that the arbitrary standards established as minimum for virus fluids suitable for inactivation were high enough to provide vaccine which would give measurable antibody response in most, if not all, subjects inoculated as prescribed. The results of the field trial (11) also suggest that these fluids were not unsatisfactory in themselves.

ACKNOWLEDGMENTS

The virus fluids referred to above and used for the 1954 field trial were converted to vaccine in the laboratories of Eli Lilly Company, Indianapolis, Indiana, and Parke, Davis and Company, Detroit, Michigan.

We appreciate the contribution of all these workers to the total project. We gratefully acknowledge the assistance and cooperation of Dr. Jonas E. Salk, Dr. P. L. Bazeley, and all the members of the Virus Research Laboratory, Pittsburgh. And we wish to thank particularly all the loyal members of our own Laboratories without whose help this work would have been impossible.

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Safety Factors in Equipment for the Application of Highly Toxic Insecticides

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SINCE the introduction of the organic insecticides to the domestic market after the war, DDT and BHC have been followed by a series of chlorinated hydrocarbon chemicals of increasing toxicity both to insects and man. Such factors as insect resistance and economic advantage have stimulated this development. It is noteworthy that the latest compound in this group, endrin, is almost as toxic to mammals as the organo-phosphorus compound, parathion.

The organo-phosphorus materials entered the field a few years after DDT. They possessed higher toxicity than any chemicals previously used in insect control. These compounds were first applied to aphids and mites but with the development of resistance to the chlorinated hydrocarbon insecticides in flies, certain additional examples such as diazinon and malathion have been introduced. While the latter compound appears to be of low human toxicity it is likely that for some time to come, chemicals possessing high killing power for insects will also be highly dangerous to man.

The trend toward increased use of highly toxic insecticides has emphasized the need for special measures to protect the health of the user. In this connection reference may be made to a recently published WHO memorandum (1) dealing with the control of health hazards likely to arise from the use of organophosphorus insecticides in vector control. This memorandum describes necessary medical control procedures. Another aspect of protection concerns the safety factor in equipment. This aspect will be dealt with in the present paper.

Prior to the war, equipment design had been in a stable phase for a considerable number of years. The dramatic developments in the chemical field following the war and the tremendous acceleration in use of the new organic chemicals in agriculture and sanitation were followed by a number of significant advances in equipment design. Most notable features of the period have been the increasing dissemination of insecticides from the air, the introduction of the airblast sprayer using the concentrated spray in replacement of the hydraulic equipment and the dilute spray. Automation in dispersal has appeared in the form of the thermal vaporizing devices. These developments have had an important effect on the safety of insecticide application.

The Safety Factor in Present-day Equipment

Study of the safety factor in use of the new highly toxic insecticides with the older equipment as well as with the new procedures has been carried out

by a number of investigators but review of the literature has shown that such studies have been mainly concerned with agricultural situations. Furthermore, overall assessment of the hazard has been stressed rather than comparison of the relative contributions of the chemical and equipment to the hazard. Little information of a factual nature has been reported on the safety factor of equipment used in environmental sanitation. Certain basic principles may, however, be set forth, some specific ideas for improvement of equipment may be recorded and a fruitful field for research on this subject can be outlined.

Application by Aircraft

A striking reduction of human hazard in use of highly toxic insecticides has resulted from the introduction of aircraft application because of the tremendous efficiency of this procedure. Barnes (2) has observed that an aircraft can accomplish in 12 minutes the work of two men for two days on 100 acres. Thus in terms of safety, the numbers of exposed workers is greatly reduced. The safety of the pilot remains a problem, and even though the first aircraft application in North America was made as long ago as 1919, many craft in use today have not reached the stage of design which provides for safety of the pilot in use of highly toxic materials.

Design of aircraft for application of current insecticides is a factor of importance when many aircraft in use are conversions of standard models. This aspect has been dealt with by Ingram (3) in California in a study of health hazards associated with use of airplanes for dusting crops with parathion. This investigator made the following observations with respect to the effect of aircraft design on safety: (a) Certain planes had the hopper located directly in front of the pilot's compartment. During loading, dust may filter and blow into the compartment and create a substantial exposure to the pilot in flight. (b) An airtight bulkhead should be provided across the fuselage behind the cockpit to prevent the entrance of dust through the tail wheel fuselage. (c) If there is no windshield, a fairing should be fixed between the hopper and the cockpit to prevent lodgement of dust during loading which will later blow into the cockpit. (d) The hopper cover should have a sponge rubber or felt gasket and should be closed as soon as filling is completed.

These observations on converted aircraft have received general confirmation recently from Manson (4) who has emphasized that better seals on cabin doors and between hopper and cabin are needed to prevent infiltration of the insecticide into the cockpit. Barnes (2) had previously noted that aircraft and equipment should be of strong construction because of the rough service conditions under which the planes are worked.

Numerous commercial models are now available for insecticide application. Study of this equipment with particular respect to the suitability for use with highly toxic insecticides has not apparently been made. For instance, the new compound, endrin, has been applied by air in trials in the United States. Such trials present the occasion for planned investigation of safety factors as well as efficacy of the material and the method of application. It is only by this approach that it will be possible to develop economical designs permitting

safe operation of aircraft without the strictures of personal protective clothing and other safety procedures in lieu of a safe interior environment.

With respect to safety in areas being sprayed consideration should be given to special marking for planes loaded with highly toxic insecticides. The warning symbol for toxic substances recently adopted by the Chemical Industries Committee of the International Labour Office would afford suitable warning in such operations.

Finally, discussion of safety aspects of equipment for air application should not close without attention being drawn to the need for special protective clothing and medical supervision until design of planes for insecticide application has produced a plane interior safe for occupancy under operational conditions.

Mechanical Spray Equipment

The hazard in ground application of the insecticide parathion by mechanical equipment has received study during recent years and ample evidence has been published to indicate that greatest care is necessary in applying materials in this toxic class with available equipment. The observations of Kay et al. (5) on hydraulic spray equipment showed that operators suffered significant reductions in blood cholinesterase when applying normal cover to apple crops in Canada. This investigation also showed that liquid sprays discharged by hydraulic equipment tended to be easily blown off direction with resulting exposure of the operator. A subsequent investigation by this group (6) on the new air-blast type of sprayer with concentrate spray indicated that the concentration of parathion in the breathing zone of the operator was substantially reduced, due either to the greater distance of the operator from the source of the spray or to the increased energy of the spray along the line of discharge and its better contact with the target sprayed. These observations on the reduced air concentration with air-blast equipment are confirmed by the recently published work of Batchelor and Walker (7).

In the course of examining the safety factors in mechanical ground spray equipment of new and old types certain suggestions for improvements in the equipment have come to hand.

Nozzles: Manson (4) has suggested that some study of nozzles in light of the more toxic materials in use would seem advisable. It is suggested that an adjustable diaphragm-type nozzle might permit self-cleaning with a minimum of contamination. At the same time the size of opening could be adjusted without a change of disks.

Windish of the author's laboratory (8) has noted that cleaning plugged nozzles is a frequent source of excessive contamination to the operator. He has suggested that study of nozzles would be desirable and directs attention to the possibility of incorporating a spring-loaded ball bearing in the nozzle opening. Cleaning could then be effected by depressing the ball and flushing the nozzle which would eliminate the need for removing nozzle from spray machine.

Micronization: Windish (8) has suggested that study be given to elimination of nozzles by the use of the micronization technique and wetting agents.

Tank Level Indicator: Beaulieu (9) has drawn attention to the hazard resulting

from opening tanks to check level of material and recommends that all tanks for highly toxic materials should have level indicators.

Dust Hazard in Filling: Manson (4) has suggested that dustiness at filling might be reduced by having the by-pass from the pump circle the tank opening, with water jets properly directed to wet the powder as emptied into the tank screen. Manson (4) presents a second possibility, that of packaging powders in standard-sized units enclosed in a water-soluble film so that, when removed from the outer container, the intact package could be dropped into the tank eliminating all dust. In England use is made of removable plastic inner containers which can be ruptured inside the tank.

Tank Filter and Drain: Fisk (10) who suffered parathion poisoning in working with a tank filter suggests that a cut-off valve should be placed between the main tank and primary filter. This grower received extensive exposure while taking out the filter screen. On replacing face plate to stop the flow after cleaning screen, the same situation occurred in reverse while putting screen back in place. Further trouble was then encountered in the nozzles. It is suggested that the main intake pipe from tank to pump should not draw completely from the bottom of the tank but should be centred over a recess (which could be removed for cleaning) so that all heavy solids would be trapped. The cut-off valve previously mentioned should be immediately under recess section.

This problem has been emphasized by Dustan (11) who suggests that drains from tanks be improved. Most drains from tanks are opened by removing a plug and when this is done the contents of the tank gush out. A conveniently located valve or tap operated from the side of the outlet would eliminate the hazard.

Liquid Formulations: There appears to be wide interest in increasing use of liquid formulations as a means of reducing hazard of dustiness at filling and to eliminate plugging problems.

Couplings, Bushings, and Packings: Dustan (11) suggests that improvements in hose couplings, spray gun bushings, and packings be studied.

Enclosed Parts: It would appear that the principle of enclosing working parts could be further exploited to reduce human contact with chemical contamination during repairs and maintenance.

Fogging and Misting Equipment

Safety factors in fogging and misting, in general, seem to be the same as for the mechanical spray applications. Published reports of ill-effects to operators in fogging and misting with current chemicals have not been found and it may be assumed that such operations have not been widely hazardous. On the other hand the physical characteristics of the aerosols and the formulations desirable in fogging and misting suggest that a substantial hazard may be expected if more potent materials are exploited in the future.

Mechanical Dusting Equipment

Little information is available on the hazard in mechanical dusting. Recent observations by the author's laboratory indicate that in crop work the use of a

trail sheet is desirable to improve contact of dust and crop, to reduce drift which may present a menace to public health and to eliminate blow back on operator.

The hazard in filling mechanical dusting equipment is substantially greater than the hazard with spray equipment because of the bulk of dry material handled. This suggests that dust control should be studied. Windish (8) suggests that redesign of hoppers be undertaken with a view to the provision of exhaust ventilation for the filling period and means for emptying bags while the hopper is closed.

Published observations from the author's laboratory on ground drift in dusting with parathion (12) indicate that normal dust discharge in vegetable covers leads to hazardous air contamination to distances of around 300 feet. These findings emphasize that further study of the potential hazard to operator and adjacent population is warranted.

Enclosure for Operator in Mechanical Application

Equipment providing an enclosure for the operator would seem to represent the ideal in safety for personnel engaged in mechanical spray and dust application work including fogging and misting over long periods. In fact, if insecticides continue to increase in toxicity it is in this direction that equipment safety will probably have to go, even for short-term work.

The author recently examined a protective air-supplied cab at Fisons Pest Control Limited, Cambridge. This equipment has been used in custom spraying operations where operator service with highly toxic insecticides is on a long term basis. Dr. E. F. Edson, medical officer, reported that no ill-effects to operators from parathion had ever been experienced when the air-supplied cab was used. Seventy are maintained by the Company. Attention is directed to the need for insulation and comfort control in hot climates.

Hand-Type Equipment

This type of equipment and the general conditions of use, especially in vector control, present a potentially high exposure to the operator. Barnes (2) has drawn attention to this aspect. In the absence of evidence to the contrary, the use of the new highly toxic insecticides in hand type equipment may be regarded as having high potential hazard unless comprehensive personal protection is provided. Adequate evidence would not appear to be available to permit an evaluation of the hazard with the organo-phosphorus compounds, diazinon and malathion, but until further is known about the hazard of these compounds, application by hand-type equipment should also include careful attention to protection of the operator. A higher degree of hazard can be expected from dusting and, in fact, it is not established that hand-type dusters could be safely used with highly toxic materials. This consideration requires investigation.

Use of liquid spray is to be preferred if sufficiently small particulization of material is effected. Reference is made to a WHO publication on nozzles by Knipe (13). Improvement of pressure regulation in compression sprayers would eliminate operation at pressures below the level suited to nozzles which

is costly in material and hazardous to operator due to the reduced spray cone and danger of splashing as droplet size increases.

Another safety aspect of hand-type sprayers concerns the possibility of liquid running down the lance onto the hands of the operator. Dustan (11) has suggested that a disc-like metal or other baffle be placed on the lance a few inches from the nozzle to prevent liquid running back.

The observations of Kay et al. (5) on orchard spraying with hand-type hydraulic equipment have indicated that this is a more hazardous operation than mechanical spraying. Barnes (2) has drawn attention to the high exposure of the operator of hand-type equipment used in malaria control. As search of the literature has not disclosed pertinent observations on the hazard of stirrup pumps and existing compression sprayers when used with highly toxic materials, it would seem desirable that study of the hazard in these applications be undertaken before extensive programmes are proceeded with.

A current need exists for study of the skin exposure and concentration of insecticide at operator's breathing zone with various combinations of pressure and nozzle tip sizes. The practical usefulness of wetting agents in improving the retention of sprays by contact surfaces should be evaluated. Certain advantages both in terms of safety and economy might eventualize from consideration of portable air-blast equipment in place of the hand-type compression sprayers.

Automation in Dispersal

Automation has not yet been exploited widely for dispersal of insecticides. Thermal vaporizing devices have been recently used in the United Kingdom for dissemination of organo-phosphorus compounds in greenhouses. In America such devices, operating on a continuous or non-continuous basis, have been used in commercial and domestic situations. The preferred insecticide has been lindane. Certain fumigation techniques, use of impregnated combustion papers and other such procedures may be mentioned as such techniques possess elements of automation.

The rationale in this principle of insecticide dispersal is strong and of special appeal in connection with dissemination of highly toxic insecticides, as exposure of personnel during operation can be entirely eliminated. Nevertheless the use of such devices to date has covered only a limited range of situations. In North America this may be in part attributed to the unsatisfactory design of early models of thermal vaporizers which in some instances failed to operate safely and in other cases effectively. With respect to domestic use, concern of public health authorities as to possible ill-effects from long exposure to the low concentrations created, has made for limited acceptance.

In view of the extensive numbers of thermal vaporizing units sold in Canada, the Department of National Health and Welfare in 1953 investigated the performance and safety features of a range of examples. Wide disuniformity in output and other basic faults were found. After this investigation, safe standards for continuous vaporizing units were drawn up under the auspices of the Canadian Standards Association (14). It was established that vaporizing units could be made safe if controls on output were incorporated and certain

conditions of application adhered to. It was not considered that the devices should be used with lindane under conditions where human exposure would exceed 8 hours per day.

Further applications of automation, commercially or in the field for remote control of insect populations with highly toxic insecticides, would appear possible. Use of such equipment with lower toxicity materials in inhabited situations would not appear to be contraindicated at present stage of knowledge if design and installation features be controlled. In fact for dispersal of insecticides of low or high toxicity in special situations the approach offers substantial economic savings permitting timed treatment without supervision.

Investigation of useful and safe applications of automation for dispersal of highly toxic insecticides might well prove rewarding in the commercial or sanitation fields where in the future, ingenuity may have to be exercised to eliminate the human element to the greatest possible degree.

Proposed Features of Equipment for the Application of Highly Toxic Insecticides

The characteristics of present-day insecticidal chemicals indicate that for some time to come, toxicity to insect and man will be parallel. As the search for insecticides of higher and higher killing power continues, the safety factor in use of such chemicals is a matter of pressing concern. In this paper, the safety factors in certain types of contemporary equipment have been examined in relation to use with the highly toxic materials. An assessment of basic considerations in design and operation of equipment for application may now be made.

Reduction of human exposure cannot be effectively and economically reached by provision of personal protective measures such as special clothing, respirators and elaborate medical control, for these arrangements are costly, require elaborate supervision and generally delimit operational range and efficiency of personnel. The basic approach would appear to be to reduce the exposure to the greatest extent possible by equipment design and operation.

Until advances in equipment design reach the stage where exposure of operator is eliminated, certain types of safety precautions will be required. Consideration should be given by appropriate authorities to preparation of standard safety instructions and recommended medical supervision for the main classes of application procedures. This could include provisions necessary for ancillary personnel.

The use of warning symbols for marking equipment loaded with highly toxic insecticides would be advantageous. A symbol for toxic materials recently adopted by the Chemical Industries Committee of the International Labour Office is recommended.

Application by aircraft eliminates human exposure in operation to the lowest degree yet known by virtue of its high efficiency in dissemination. It would therefore appear that this method should be as widely employed as practicable and consistent with the safety of inhabitants in areas adjacent to and under treatment.

The main fault in air application equipment appears to be the use of aircraft

designed for other purposes and converted for insecticide dispersal. Special structural features cannot be properly incorporated. The fuselage is not or cannot be proofed against entry of insecticide. It should be basic in design that the pilot shall operate in an environment which eliminates need for protective clothing—in an aircraft structurally designed for the flight conditions and the operation being performed.

Investigation of suitability of commercially-available aircraft for use with highly toxic insecticides would seem to be warranted.

Mechanical ground equipment reduces the human exposure in operation and for this reason should be as widely employed as practicable. It has been established that air-blast designs with concentrated sprays are safer than hydraulic equipment. Enclosure of the operator is a highly desirable procedure and warrants research with respect to development of economically-feasible designs for use under various climatic conditions. Enclosure of working parts should be a basic feature of design to eliminate hazard from contamination in repair and maintenance.

Evidence has been presented to indicate that further advances in nozzle design or alternative arrangements such as micronization would be in the interests of safety. Elimination of plugging is a basic requirement in avoiding dangerous human exposure. Other suggested safety features for this type of equipment might include tank level indicators, cut-off valves between tank and filters, dust collection arrangements for use at filling, improved tank filters and drains. Elimination of dust exposure at filling is strongly warranted on the basis of past experience. Development of special packaging features should be pursued by the industry.

Basic considerations applicable to mechanical spray equipment will apply to fogging and misting equipment. Special safety features should be explored by a study of fogging and misting with highly toxic insecticides. There is evidence to indicate that the hazard of dusting should be given further study.

The prospects for safety in use of highly toxic insecticides with hand-type equipment do not appear encouraging. However, this type of equipment has a place in special situations and is widely used especially in the underdeveloped countries. It would therefore appear valuable to undertake studies on the problem. These should be directed toward establishing the design of equipment which will provide maximum possible safety.

Pressure regulation would appear to be a factor in safety of compression sprayers. Provision of a feature which would prevent spray liquid from running back down the lance might be considered. The usefulness of wetting agents in increasing contact between spray and target should be evaluated in the interests of reducing blow-back. Portable air-blast equipment in place of hand-type compression sprayers should contribute to safety and experiments on this subject would be valuable.

Automation in dispersal of highly toxic insecticides under appropriate conditions presents the possibility of eliminating human exposure. In fact for dispersal of insecticides of low or high toxicity in special situations, the approach offers substantial economic savings in labour, permitting timed treatment without supervision. Study of automation could well prove rewarding in the commercial or sanitation fields.

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Letter from Great Britain

Social Surveys in Britain (Housing)

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THE past fifteen years in Britain have been remarkable for development of public health thinking and action in the social field, in many ways which we have discussed in these letters. Much of the new emphasis has been due to the stimulus of the social survey, as well as to the detailed knowledge to which it has given rise. The signs of illness in the group need to be studied against the background of the life of the community, just as physical signs in the individual, for their interpretation in clinical work, need to be seen in the setting of the patient's history. The study of the life of the community is conducted by means of the survey—social, socio-medical or purely medical. Surveys in Britain in the last few years have ranged widely over a multitude of aspects of our national life from studies in feeding habits to the examination of the social background of old persons seeking admission to hospital. But none has been so valuable as those relating to housing.

In my recent article (1) I spoke of the continued existence of overcrowding and house sharing as a feature of our industrial scene. These phenomena do not affect all types of families and all sorts of areas in the same way. What, for example, is their relationship to the growing family. Barbara Thompson, an almoner at the Aberdeen Maternity Hospital, inquired into the housing conditions of women booking a bed for delivery in hospital (2). The inquiry was based upon the records of 2,086 married women, representing two-thirds of the total legitimate births in that city. Eight hundred and thirty lived in council houses and 1,256 in private property. The study brought out very clearly the prevalence of house sharing during the period when the young family is being brought into existence. *Half the families shared a home* (one in four of these families were strangers). Perhaps most significance should be attached to the findings about the housing conditions of primagravidae; three-quarters (71%) of primagravidae shared a home. Whereas overcrowding increased very markedly in the general run of family from social class I to social class V (4% in classes I and II, 16% in class III and 31% in class IV and V) among the primagravidae house sharing was marked in all social classes (57% in I and II, 68% in III and 82% in IV and V); one in five primagravidae lived in furnished rooms sublet from strangers without any security of tenure.

Of the 1,137 expectant mothers living in shared dwellings, only one in four had exclusive use of as many as two rooms; 1,011 had one room, often with a shared common living room. Council houses were more often shared and overcrowded because of the high cost of rent and travelling and other overheads. Thus, three-quarters (78%) of council houses were shared compared with 38% of private property, and 28% of council houses were overcrowded in comparison with 14%.

The phenomenon of house sharing can hardly be confined to Aberdeen. James Spence and Stanley Walton, in their account of the "1,000 Baby Study", suggest that much the same may be happening in Newcastle-upon-Tyne. It is a fair presumption, although we have no absolute proof, that this situation is present widely throughout the country.

Frustration, irritation and tension of house sharing are obvious. The longing for independence leads on the one hand to postponement of marriage and on the other, since new houses tend to be allocated to couples with at least two children, it may lead to frequent children in the hope of qualifying for a council house. Many seek inadequate alternatives to the shared house in the one-roomed tenement.

House sharing may well be the greatest single cause of insecurity, worry and unhappiness among those with young, growing families. How important it is that accurate information of its presence within our community should be obtained.

Other studies have shown how much slum living conditions have improved. In Glasgow, 388 families living in slum property have formed the basis of a survey by the Department of Social Medicine (3). The sample contained 1,693 persons with an average family size of 4.36, and a density of 2.52 per room. Rather under half (46%) were living at three or more per room. The details recorded for the sample included the condition of the houses, rent, length of tenancy, the survival rates of father, mother and children, occupation, lodgers, and certain financial details such as housekeeping, insurance and hire purchase, clubs and checks. By great good fortune the Glasgow school were able to compare their results with records of slum dwellers of 70 years ago (as recorded for 1881–94 by Russell, Medical Officer of Health) and 135 years ago as recorded by Graham and Cleland (The Rise and Progress of the City of Glasgow 1820). The actual density of living does not appear to have altered greatly. In 1819–20, Glasgow's 147,197 people lived in 31,445 houses at an average density of 2.06 per room; no doubt slum dwellers were living at much higher levels. In 1881 the average density of the whole town was 2.05 per room, and in 1874, 990 slum families were recorded as living at an average of 2.4 per room.

Clearly an exact comparison was not possible but available information left little doubt that vast improvements had taken place. The atmosphere was better; the families were better; and feeding habits were superior. Employment had become general whereas in previous records the slum dweller suffered from chronic unemployment. The present Glasgow Slum-dweller, of whom many are skilled or semiskilled operatives, earns good, steady, regular wages and in striking contrast with last century he is a permanent dweller in place

of a bird of passage. In 1894 Russell wrote "If you note the length of occupation of each tenant who holds direct from the factor, you will find that half of them have been in the house in which you find them less than a year; and a third of that half, or nearly 17 per cent, less than one month." The present sample showed that nearly half had been in their present home for 10 to 20 years and one-fifth for more than 30 years. Poverty no longer appears to be the major factor in driving people to a slum.

An interesting study of the difficulties encountered by a housing authority in allocating new houses has been made by Warren (4). An extreme shortage of new accommodation exists in the London Borough of Hampstead. The problem resolved itself into one of selecting a few only from the many who had urgent reasons for removal. In an analysis of 1,028 medical certificates, the medical officer of health had to discriminate between the conflicting claims, e.g., of respiratory disease (25%), rheumatic disorders (15%), psychological abnormalities (14%). What emphasis, he asked, should be given to the known risks of overcrowding to young children or to the dangers of spread of tuberculosis? His only possible means of arriving at a fair decision was to use a meticulous system of marking, with points given according to a schedule for a wide range of aggravating factors. He found it necessary to dissect the medical cause given into its component parts and to mark accordingly. Thus, for example, tuberculosis would score according to (*a*) its infectivity, (*b*) its contacts, (*c*) the age of contacts, (*d*) the extent of house sharing, etc.

These studies of the social factors of housing indicate clearly the value of the survey. It is to be hoped that universities and health departments will continue these very necessary studies.

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Non-Profit Medical Care Insurance in Canada: Problems of Universal Coverage

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AT the outset I would like it understood that the remarks I am about to make represent my own personal opinion, and can in no way be construed as representing the views of my Department. My comments are the outgrowth of some of my studies as a research worker in the field of medical and hospital care.

I notice that the program suggests that I am to discuss "comprehensive coverage" based on a survey of voluntary and commercial health insurance in Canada. I should perhaps point out that the survey recently completed in the Research Division, of the Department of National Health and Welfare, dealt only with the voluntary non-profit medical care plans. The Canadian Life Insurance Officers Association, in conjunction with the All Canada Insurance Federation, has just published a booklet entitled "Financing Health Services in Canada" which gives some important data for 60 commercial insurance companies. I would prefer to confine my remarks at this time to the experience of the fourteen major non-profit plans providing protection against the costs of physicians' services.

First I would like to try to define exactly what I mean by the term "comprehensive coverage" under the voluntary non-profit medical care insurance plans in Canada. Most writers in this field have used the term with reference to the range of benefits offered under different contracts. A comprehensive contract is one which provides a wide range of benefits, including payments for each of the following services: physicians' calls in home, office, and hospital; consultations; surgical operations and procedures; confinements; anaesthesia; and x-ray, laboratory and other diagnostic procedures.* A comprehensive service contract is one which offers all these benefits on a service basis—not by indemnifying the patient for a portion of his expenditures on these items, but by entering into a contract with doctors who agree to accept the amounts paid by the plan as full payment for the services they have rendered to members. The member is required to pay nothing out of his own pocket except the premium.

Manitoba Medical Service is the only plan in Canada which offers a comprehensive service contract on this basis: it is the only plan which guarantees

*There is, of course, the question as to whether some of these benefits might alternatively be provided under hospital care insurance.

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all its members that they will not be billed extra amounts by specialists or general practitioners. The Medical Services Association plan in British Columbia comes close to this definition, but specialist care in non-referred cases does not carry this guarantee, and any general practitioner or specialist who provides so-called luxury services may arrange with the patient beforehand to charge additional fees. Similarly, Windsor Medical Services and Les Services de Santé du Québec guarantee their low-income members that neither general practitioners nor specialists will extra-bill. However, if we accept as a service plan any plan which has a contract with *general practitioners* not to extra-bill, then there were in Canada in 1953 nine service plans, covering 1.1 million people for comprehensive benefits, or about 7½ per cent of the total population. In addition, another 100,000 persons were covered by these plans for limited benefits, mostly surgical and obstetrical care, with or without medical attendance in hospital. The remaining five non-profit plans operated on what might be called an "indemnification basis". Without entering into contracts with doctors who would provide services to members, these plans guarantee to reimburse members for their medical care expenses up to certain fixed maximum sums for each type of service rendered; charges beyond these maxima are the responsibility of the insured member. These five plans covered another 1.1 million persons for a more limited range of benefits, excluding medical care in the home and office.

NUMBERS AND PERCENTAGE OF PROVINCIAL POPULATION ENROLLED FOR COMPREHENSIVE AND LIMITED BENEFITS, BY PLAN, 1953

Plan	Comprehensive No. Covered	Percent of Population	Plan	Limited No. Covered	Percent of Population
MSA–B.C.	228,685	17.4	MMS–Man.	12,379	2
MSI–Alta.	58,827	5.9	PSI–Ont.	77,663	9
MSSI–Sask.	92,530	13.9	WMS–Ont.	1,195	
GMS–Sask.	26,768		AMS–Ont.	111,530	
MMS–Man.	158,632	19.6	CMSF–Ont.	43,201	
PSI–Ont.	313,321	9.2	OHA–Ont.	204,171	
WMS–Ont.	139,003		SSQ–Que.	16,414	14
SSQ–Que.	35,000	0.8	QHSA–Que.	586,563	
MMC–N.S.	52,129	7.9	MHSA–Atl. P.	162,547	10
			MMC–Atl. P.	406	
Total	1,104,895	7.5	Total	1,216,069	8.2

It is estimated that in 1953 the service plans spent about $19 million, or $17.45 per capita, on medical care benefits, while the indemnification plans spent about $8 million, or $7.35 per capita. Physicians' calls accounted for about 44 per cent of the comprehensive plans' benefit expenditures, surgery for about 30%, laboratory and x-ray services for about 11%, confinements for 6%, and miscellaneous items for 9% of the total.

Persons insured under the Manitoba Medical Services comprehensive contract received about 4½ services per person in 1953. Another plan, with a membership that has been fairly constant over the last few years, reported a fairly stable per capita volume of services during the eight years from 1944 to 1951, increasing from 3.3 in 1944 to 3.6 in 1947, and to 4.2 in 1948 and 1951, which

suggests that the volume of services per person can be stabilized over a period of years as families continue under insurance care.

Let us suppose, as a hypothetical case, that Manitoba Medical Service, with about 20% of the total population now covered comprehensively, wanted to extend this membership to cover practically the whole population of the province. In mentioning some of the difficulties that would have to be overcome in Manitoba, I am assuming that most of these problems would have general applicability for the whole of Canada.

1. Are there sufficient medical resources available—enough doctors, hospital beds, diagnostic facilities, and technical personnel? Are these resources distributed throughout the province on a satisfactory basis, so that all members would have access to the necessary facilities? The adequacy of existing resources depends both on the way these resources are used and the demands for services. Modern medical practice has changed considerably in the past 15 years, and now relies heavily on specialist consultations, and a wide range of laboratory and other diagnostic services, as well as "miracle drugs" and "miracle surgery". Certain methods of organizing these services are possible which might use the existing resources more economically.

2. Adequacy of resources cannot be determined, of course, without some measurement of the probable demand for services under a comprehensive benefit program. If the whole provincial population were enrolled for comprehensive medical care, would the volume of services of all kinds that are now provided per person tend to increase? Formerly, a clinical approach was taken to solve this problem, using the Lee-Jones averages to determine what amount of care is required for various disease conditions. Now we have the experience of existing comprehensive insurance programs upon which to base our expectations of demand for services, when the financial barrier to adequate care has been removed. Preliminary tabulations of the Canadian Sickness Survey show that the average Canadian is now receiving considerably fewer home and office calls than the average Canadian who holds comprehensive medical care insurance. It seems reasonable to assume that Manitobans are not now getting all the care they would demand under insurance coverage. We do not yet know, however, what effect several years of continuous insurance coverage under Canadian "service" plans will have in improving a family's health and, therefore, in reducing the volume of services it will require. And whether or not the increased demand for services on the part of all those not now insured would change Manitoba Medical Service's present rate of about 4.5 services per person, is impossible to say.

3. Are the non-insured members of Manitoba's population able to pay the costs of enrolling under Manitoba Medical Services?

At the present time, a premium of $6.60 per month, or $79.20 per year, is paid by family subscribers to the "B" contract.* In addition, $37.20 must be paid for public ward hospital care insurance, or $50.40 for semi-private coverage. The families of Manitoba must now pay at least $116.40 every year for medical and hospital insurance, plus additional sums for dentistry, drugs, and other health services.

*Single persons pay $33.00 per annum.

Both the Canadian Sickness Survey in 1951 and a national family budget survey in 1948 indicated that the average middle income family in the three prairie provinces spent 3.7 per cent of family income in those years for health care services of *all* types. Included in this expenditure, the Sickness Survey shows about 1.2% of income spent on medical care services, either prepaid or paid directly to physicians.

The average annual wage per paid worker in Manitoba was only $2,850 in 1953 ($2,970 for all Canada). Having in mind that about 10% of married women in Canada are gainfully employed, and that family income is sometimes supplemented by working children, it would appear from the best evidence† available that at least 60% of Manitoba families received a gross income of less than $3,000 in 1953. If the average worker were to spend 3.7% of his income for health care, he would have paid out about $105 in 1953 for *all* items of health care, including about $35 for physician services. Yet we expect the average Manitoban to pay almost $80 for medical care insurance premiums alone (or $98 if doctors are to be paid 100 per cent of their fee schedule). Can the average Manitoban be re-educated to the point where he is willing to spend 4 to 5% of his income on medical and hospital care insurance alone, quite apart from such other high-cost items as dental care and drugs? Can he be asked to increase his expenditures on medical care from $35 to $80 or more per year by enrolling in Manitoba Medical Service, especially when over 80%* of all Canadian middle-income families ($1,500–$3,000) covered by the Sickness Survey in 1951 spent less than $40 on direct payments for physicians' services? There are many obstacles to be overcome.

Family budget data indicate that the average city family spends about 85% of its budget on food, clothing, shelter, insurance, taxes and pension contributions. Although family age-sex composition will vary the weight of these components in the budget, it seems that the average family is left only 15% to cover transportation, education, recreation, tobacco and personal care, as well as all items of health care.

The above evidence would tend to support the view that at least 60% of Manitoba's families would probably find it very difficult at the present time to meet the premium charges for comprehensive family coverage under Manitoba Medical Service. The gap between the estimated average direct and indirect payments to physicians of $35 now spent, and the $80 in premiums that would be required, appears to be a major obstacle for the average family to bridge without some help from outside sources. Before discussing the possible forms of such help, I would first like to mention a fourth difficulty.

4. Are the non-insured members of Manitoba's population *willing* to pay

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†Manitoba wage-earning families reported in the 1951 Census that the heads of 34% of these families earned less than $2,000, 62% earned less than $2,500, 79% earned less than $3,000, and 93% earned less than $4,000. These families accounted for 53% of all reporting families or 60% of all labour force families. By 1953, it is estimated that the average annual wage per paid worker had increased by 14.2%, and that therefore 62% of heads of wage-earning families earned less than $2,855. The average net income of farm operators in Manitoba is estimated to be $2,112 in 1953, based on a total net income from farm operations of $110,611,000 received by 52,383 farm operators.

*Including 96% of one-person families, 86% of two-person families and 78.5% of three-or-more-person families.

comprehensive insurance premiums, even if they are able to do so? Such people may have already decided that hospital care insurance and surgical insurance are more important to have than comprehensive medical care insurance, which they may feel they cannot afford. Or some people, particularly young married couples, may consider themselves to be such good "health risks" at the present time that they have no need for medical care insurance. It is of interest to note that, although only 18% of Manitoba Medical Service families are of the "two-person" variety, the 1951 Census shows that 40% of Winnipeg families† were two-person families. Any campaign to expand coverage on a province-wide basis would have to be directed towards overcoming such unwillingness to enroll in the scheme. An educational program might be necessary to persuade people that it is in their interests to have such comprehensive coverage. And this suggests a fifth difficulty:

5. What degree of compulsion, if any, is to be utilized in expanding coverage to the whole province? At the present time, many of the Canadian plans use a form of compulsion in their requirement that 75% of the workers in an establishment must enroll before the group will be accepted. To achieve this, collective bargaining, the incentive of employer-sharing together with "check-off" of premiums from wages, or other pressures, are employed. Similarly, enrollment through rural community groups, such as under Saskatoon's community contract which requires 80% participation by the municipal ratepayers, also involves a degree of local pressure, including the collection of premiums through the municipal tax structure. The Sickness Survey data, and the declining rates of growth of the non-profit plans, appear to indicate that, at present premium levels, based on operations largely involving group enrollment, the field may be nearing the saturation point for the middle income groups.

6. What measures might be taken to improve the ability of low-income families to meet the premiums?

At the outset, agreement must be reached as to what constitutes a low income. If the average family could be persuaded to increase its medical care expenditures from 1.2 to 2% of income, then a $4,000 income would be needed to meet an $80 premium. As previously mentioned, about 60% of Manitoba families are believed to earn under $3,000, and would therefore qualify for some form of financial assistance. But it must be kept in mind constantly, that any form of subsidy must be borne ultimately by the public at large.

The most obvious method of subsidy, though possibly not the most desirable one, is the practice of "employer-sharing", where the employer pays part of the insured worker's premium. The 1953 Survery of Working Conditions indicates that over 70% of manufacturing establishments in Canada with some sort of a prepaid benefit plan (including medical, hospital, or cash-compensation-for-wage-loss plans offered by private or non-profit insurance companies) —over 70% of these employers paid a portion of the premium on behalf of the insured worker. Fifty-five per cent of these employers paid at least half the premium, and 7% paid the whole cost.

Or, governments, whether municipal, provincial or federal, might be pre-

†Or 32% of Manitoba families.

vailed upon to subsidize premiums on behalf of low income members. If, however, governments are called upon to contribute public funds, the elected representatives of the taxpayers would no doubt insist on public accountability for the way the money was used.

A final point to be considered is the possibility of reducing the premiums themselves if the lower income groups are to participate. It is frequently suggested that premiums could be reduced by narrowing the range of benefits offered—different packages of benefits could be offered at different prices to suit the various income levels. But if the objective of prepayment schemes is to keep families under constant medical supervision and to meet their full medical requirements, other methods of reducing costs seem preferable. However, an important effect of providing something less than comprehensive protection might be an increase in the proportion of family income allocated to health care. That is, if some families are committed to prepayment of expenditures for basic care, and make direct payments for supplementary services as the need arises, their total expenditure on health care might command a larger share of their budgets. Dr. Anderson mentioned that this was the experience of insured American families covered in his survey.*

It is possible that deterrent charges might reduce the volume of services, and therefore costs to the plan, and these reductions might in turn be passed on in the form of lower premiums. But deterrent charges, in my opinion, should be selective—should be applied at certain rates to particular services for particular income groups, if they are to prevent abuse in the most desirable manner.

If a province-wide scheme were in effect, it is possible that the actual per capita costs of running the program might be diminished, particularly if Manitoba Medical Service's utilization rates decreased. I say this because, although the aged and indigent would undoubtedly require more than the average number of services per capita, they represent a very small proportion of the total population, and their demands for services might be more than offset by a lower utilization rate in the rural areas, at least until resources in these areas increase to meet the increased demand.

However, to illustrate the effect of a province-wide scheme on Manitoba Medical Service's level of services and costs, let us assume that there would be no change in the utilization rates, even though a large section of the rural population not now covered were enrolled under the comprehensive "B" contract. Assume also, that the age, sex and marital distribution of the total population is comparable to that of Manitoba Medical Service's present membership. In 1953, 134,000 persons enrolled under the "B" contract received an average of 4.48 services per capita. On this basis, the total non-institutional population of Manitoba in 1954 (800,000 persons) would require 3,585,760 services. If we assume further that the existing number of doctors

*Odin W. Anderson, *National Family Survey of Medical Costs and Voluntary Health Insurance*, (New York: Health Information Foundation, 1954), Appx. 2, Table 5, p. 36. Median net charges for hospital, medical, and dental services, *apart from insurance benefits*, were $117 for families with insurance and $63 for families without insurance, in 1952–53.

in the province—681* could cope with this number of services, the average doctor would be providing 5,265 services each year, including 2,377 office calls, 715 home calls, 421 hospital calls, and 196 surgical operations.†

The average per capita claims for services, rendered by doctors under the "B" contract in 1953, amounted to $25.37. When these claims are prorated at 80% of the fee schedule, and administration costs are added ($1.85), the total cost for the average family (3.6 persons) in 1953 was $80.00 ($79.74). With the existing utilization rates and fee schedules, it would cost Manitoba Medical Service $16 million to extend benefits to the whole population, or $20 million if the doctors were paid 100 per cent of their fees. The average doctor, providing over 5,000 services as mentioned, would then receive a gross annual income of $23,800, or $29,800 if there were no prorating or discounting of fees. Incomes at this level might, over time, result in an increased number of doctors, either by a movement of doctors into the province, or, over the long run, an increase in the training of doctors.

Since the fee schedule upon which these costs are based was inherited from the pre-insurance period, without regard to the effects of insurance practice on the volume of service, it is possible that a re-examination of the fee schedule might reveal particular areas where costs could be lowered. The fee schedule should be related to the increased volume of services which has resulted from the practice of prepaying medical care. Plans generally have implicitly recognized this fact in prorating doctors' claims when premium returns are not sufficient to meet total claims; yet it does not seem altogether fair to discount all claims for every type of service at the same rate, without regard to the nature and importance of the service involved. Furthermore, as mentioned, modern medical management has changed drastically in the past fifteen years or so, including the use of new drugs, and diagnostic and surgical techniques. There may be a lag in the administrative adjustments of prepayment plans to these changes, which deserve closer study.

Non-profit medical care insurance plans, both limited and comprehensive, have now enrolled over 2.3 million Canadians. After spectacular periods of growth, there is evidence from the Sickness Survey and other sources that some of these plans are no longer growing at the rates previously experienced. If these plans are to offer their insurance protection to larger segments of the population, they will have to consider methods by which groups not now protected can be enrolled. Premiums for medical care insurance represent a substantial burden on the available portion of the budgets of the low and middle income families. One problem is to convince the public that a larger share of their individual budgets must be allocated to health care costs if adequate health services are to be received. Assistance might be provided in meeting premiums, either by employer-sharing, or by seeking subsidies from public authorities. But no matter what methods are adopted, the medical insurance

*448 general practitioners and 233 specialists.

†If we assume that the initial rural utilization rate would be 75% of the urban rate, then a total of 3,131,610 services would be required, or 4,600 services per doctor, who would receive $26,029 gross at 100% or $20,823 at 80% of the fee schedule.

plans, as they enter new phases in a rapidly changing situation, may wish to re-examine the nature and composition of the fee schedules which have been adopted.

The achievement to date of the medical insurance plans is very impressive. On the assumption that the plans consider it desirable to offer comprehensive protection to a very large part of the population, it will be interesting to observe the particular methods by which different plans in different parts of Canada experiment, in order to deal with some of the problems I have indicated.

COMING MEETINGS

Ontario Public Health Association

and

Canadian Institute of Sanitary Inspectors
(Ontario Branch)

ROYAL YORK HOTEL, TORONTO

OCTOBER 6 - 8, 1955

The Whys and Wherefores of Program Evaluation

B. G. GREENBERG, Ph.D.[1] AND B. F. MATTISON, M.D., M.P.H.[2]

THE evaluation of health programs covers a wide variety of meanings, referring in some cases to an inventory type of listing, in others to a diagnostic tool, and still in others to a measurement of the effectiveness of a program.

Historically speaking, the term evaluation has come into vogue in public health at an increasing rate of speed during the past decade. This tendency has been paralleled by its growth in popularity among all behavioral sciences. For instance, an examination of the titles of papers found in the current journals read by public health personnel, social workers, psychologists, sociologists, and economists reveals a large proportion containing the word evaluation whereas a similar finding is not true among papers published a score or more years ago.

This sudden increase in fashion of the word evaluation probably stems from our culture and economy that puts a premium upon efficiency in administration and activities such as operations analysis. No longer does the private physician's medication to his patient go unquestioned. A tone of skepticism, characterized by an attitude of healthy questioning, pervades many traditional activities. The motives and ideologies of the clergy, business, government, education, military, and labor—all of these have been the subject of close scrutiny and management surveys in the recent past. Why should public health be exempt? If health program evaluation has resulted from this trend, it has been a pragmatic approach with little chance of its apparent popularity being dissipated in the near future.

DEFINITION

The definition of evaluation given in Webster's New International Dictionary is a disappointing one for the present purpose. This omniactive concept rated only three small lines of print, "to ascertain the value or amount of; to appraise carefully". In fact, the definition for research is much more appropriate to denote what is usually meant by evaluation in public health. That definition, in part, reads as follows: "critical and exhaustive investigation or experimentation having for its aim the discovery of new facts and their correct interpretation, the revision of accepted conclusions, theories or laws, in the light of newly discovered facts, or the practical applications of such new or revised conclusions".

An inquiry into how and why the word evaluation is used currently in public health with so many different meanings may serve as a suitable starting

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point in this discussion. This may also explain why public health workers are and should be extensively engaged in evaluation.

The development and popularity of program evaluation among health workers are not unrelated to the specific steps taken in public health to reach certain goals. To illustrate these steps, an analogy is introduced between the individual physician in clinical practice concerned with the health status of a single person and the public health worker dealing with the community at large.

A parallelism exists between the clinician who examines the eyes, ears, nose, throat, glandular, respiratory, circulatory, gastro-intestinal and nervous systems in order to understand what is going on in his individual patient with the public health team which studies the anatomy of the community in order to understand and interpret disease patterns as they affect masses of people. Varying disease patterns for different communities occur not only because of population characteristics but also because of occupation, geographic, climatic, geologic, and cultural factors as well.

The types of information necessary to analyze and diagnose the individual patient's anatomy, however, are very different from those needed for the community structure. Let us examine the analogy in more detail to see where the parallelism exists and how it is embodied in different techniques.

First, there must be developed an awareness of the need for medical care. In the case of an individual, it usually takes the form of a presenting complaint. In the case of the community, it is more subtle and has its origins back in the organization of the health department itself. From that point on, the community may increasingly rely upon its health department to recognize and help to develop its awareness for medical care. But just as the private physician educates the patient to be an individual guardian of his own health by the detection of early danger signals and through periodic general physical examinations, the health department must educate the community to a like degree.

Subsequent to the awareness of a need for medical care, the private physician usually proceeds according to the following chronological sequence:

Diagnostic Procedures

Case history (in addition to the presenting complaint and its characteristics, record is made of age, race, sex, occupation, education, and other items); physical examination; laboratory tests and other diagnostic procedures and diagnosis (inferences ranging from speculation to certainty). Secondly, treatment and finally, follow-up of therapy.

The health worker, proceeding in an identical manner, may concentrate at certain stages and pass lightly over others. The sequence can be summarized as follows:

Case history

(a) Study of population and its demographic structure. (b) Study of environmental, geographic, climatic, and other factors in the community.

Physical Examinations

(a) Further detailed study of environmental influences by inspection methods. (b) Sample surveys and censuses to measure prevalence of disease conditions, level of immunization, and others. (c) Inventories of that which is being

done or performed in the community with regard to health and health problems by all persons and agencies.

Laboratory and Field Tests

(a) Use of tools of community diagnosis commonly referred to as vital statistics and morbidity rates and ratios. (b) Use of approved standards for comparative purposes.

Conclusion or Inference

In terms of the health needs of a community.

Treatment

Certain social actions may be instituted for specific purposes, such as more clinics, specialized programs, or other public health measures.

Follow-up of effect of treatment on community

(a) Relationship of treatment to the elimination, correction, or remedial action indicated by the diagnosis. (b) Relationship of accompanying beneficial or malignant side-effects. (c) Considerations of cost.

The use of the term evaluation might best be restricted to the final step only, follow-up of treatment, and to apply instead the word diagnostic research to any stage of diagnostic procedures and treatment noted above. The advantage of this limitation is that evaluation and its methods can then be discussed without a divergence of opinion as to what it means.

It may be argued that, under the definition given by Webster, measurement of the health needs of a community is properly called evaluation.* Although true, such a definition beclouds the issue as to what is implied by evaluation of a program. For instance, under the broad definition one does not know whether evaluation of a program means to determine the *need for a program*, to *inventory the amount of service rendered* by a program, or to *measure the results* of one in terms of accomplishment of objectives. The latter is the preferred definition if confusion is to be avoided.

If evaluation connotes in health work that aspect alone referred to as follow-up of therapy, it affords a means of expressing quantitatively an effectiveness quotient by relating the results of therapy to the objectives. For example, does a particular vaccine, program, service, or clinic promote or produce the objective for which it was instituted, or, which of several competitors performs more efficiently?

If evaluation is considered in terms of results, the next phase is to inquire about acceptable objectives for health programs. From a long range aspect, there are but two ultimate objectives in public health—the reduction of mortality and morbidity. (Morbidity is used here with the World Health Organization definition in mind to include in addition to somatic disease the overall features of mental health, social well-being, and crippling conditions.)

In most programs engaging the attention of the health worker today, such ultimate objectives are too distant in the future, or insensitive, to be worthwhile indices for evaluating a program. Consequently, a multitude of acceptable intermediate goals are substituted. These take various forms, such as the attainment of standards, or modification of cultural patterns of

*Such measurement usually consists of an inventory of what is being done in comparison to an accepted value system available in the form of a manual of approved standards. This is particularly true in the sanitation, laboratory, nutrition, and maternal and child health areas.

behavior. The intermediate goal involves present actions or attainments which will lead later to a reduction of morbidity or mortality.

These intermediate aims are based upon the postulate that morbidity and mortality will eventually be affected if a series or chain of prior accomplishments are fulfilled. They are not endpoints in themselves. The substitution of intermediate goals recognizes the decline in the sensitivity of vital statistics and morbidity rates as tools for both diagnosis and evaluation. In fact, their decline has stimulated evaluation by procedures that measure effectiveness in terms of accomplishing intermediate goals just as their decline has also created the need for additional tools in diagnosis.

Illustration

To be more specific about acceptable intermediate goals, a situation with regard to health educational literature may serve as an illustration. Suppose that a health official is anxious to learn how effective a piece of literature on prenatal nutrition has been for the eventual purpose of reducing morbidity and mortality.

Acceptable intermediate objectives that might be used in evaluating the effectiveness of the material are shown in Figure 1. Reading the chart from bottom to top, one intermediate goal might be the fulfillment of a readability formula. In that event, the literature could be considered as having been evaluated if it passed one of these formulas with a satisfactory grade. In terms of the ultimate objective, however, this kind of evaluation assumes that the literature will reach a large proportion of the population for whom it was intended, that it will be read, that it will have some effect (sooner or later, direct or indirect) in motivating the reader to carry out the recommended procedures, and that eventually a reduction in mortality will ensue. Evaluation is more accurate in terms of the final objective when the intermediate goal approaches as closely as possible to it. This eliminates most of the uncertainty about the fulfillment of the succeeding steps.

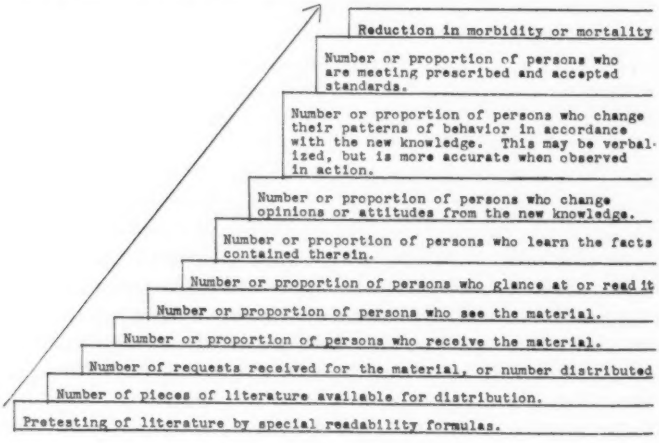
Reduction in morbidity or mortality
Number or proportion of persons who are meeting prescribed and accepted standards.
Number or proportion of persons who change their patterns of behavior in accordance with the new knowledge. This may be verbalized, but is more accurate when observed in action.
Number or proportion of persons who change opinions or attitudes from the new knowledge.
Number or proportion of persons who learn the facts contained therein.
Number or proportion of persons who glance at or read it
Number or proportion of persons who see the material.
Number or proportion of persons who receive the material.
Number of requests received for the material, or number distributed
Number of pieces of literature available for distribution.
Pretesting of literature by special readability formulas.

FIGURE 1.

A step-wise chart to illustrate intermediate and ultimate objectives that might be used in evaluating the effectiveness of a piece of health educational literature.

The first step, then, in evaluating a program is a clear-cut statement of the objectives, both intermediate and ultimate. The person best qualified to state these is the one responsible for instituting the program.

If and when an intermediate goal has been agreed upon, the criterion for measuring successful achievement of this objective is the next step in evaluation. How does one decide that a sufficient body of knowledge has been learned?

There is no unique answer to this question since each problem requires particular attention. Selection of those criteria which measure fulfillment of the objective will usually involve the previously mentioned program director as well as resource persons who specialize in related fields, including statistics and tests and measurement.

The third step in evaluation is to design an experiment or research program which will measure accurately and precisely the criteria of success previously developed or adopted. Such experimental designs are best incorporated into a program at its inception, or shortly thereafter, making an early evaluation possible. It is exceedingly difficult, and often times impossible, to evaluate unequivocally a program in retrospect. Dorn (4) has pointed out the limitations imposed upon valid inferences resulting from retrospective situations.

Design of Evaluation Studies

Certain fundamentals in designing this third phase merit further consideration because they are too often unknown or overlooked. In Figure 2, a flow chart is presented which indicates optimal procedures to follow in measuring the criteria of success adopted in the previous phase.

Reading the diagram from left to right, the first item points out the need for a clear definition of the population to be exposed to the program under evaluation. This group, referred to as the "target population", is the one for whom the therapeutic program is intended, and the one about whom inferences will be drawn concerning effectiveness. The target population is demarcated in most instances by the program director.

From the target population, a smaller group, labelled the "sample population" may be chosen for the intensive follow-up of the therapy. The sampled population should be selected according to the principles of "probability sampling" in which each individual of the target population has a known probability of entering the sample.*

It is usually desirable to be able to identify particular subgroups within the sampled population so that individual variations of the program's effectiveness may be pointed out. To do this, the *sampling plan* must be representative. Individual subgroups are not necessarily represented in the sample in identical proportions or proportional to relative size. A worthwhile discussion of the principles of probability sampling may be found in Cochran, Mosteller and Tukey (3). The statistician will usually be responsible for selecting the sampled population.

The sampled population, consisting of an aggregate of experimental units, is then divided according to some experimental design, into two homogeneous

*In a limited number of evaluation problems, measurement of the effectiveness of the program may be unaltered even when the sampled population is not a probability sample, or at all representative of the target population. This occurs infrequently, such as when a program is relatively independent of the persons in the target population.

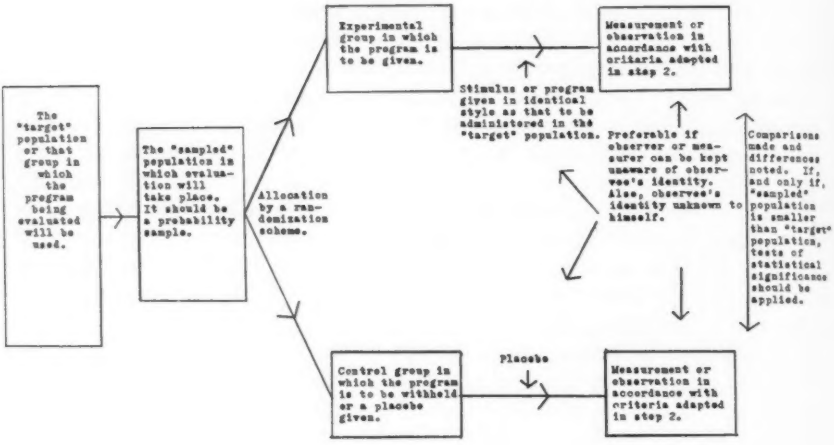
The "target" population or that group in which the program being evaluated will be used.
The "sampled" population in which evaluation will take place. It should be a probability sample.
Allocation by a randomization scheme.
Experimental group in which the program is to be given.
Stimulus or program given in identical style as that to be administered in the "target" population.
Measurement or observation in accordance with criteria adopted in step 2.
Preferable if observer or measurer can be kept unaware of observee's identity. Also, observee's identity unknown to himself.
Comparisons made and differences noted. If, and only if, "sampled" population is smaller than "target" population, tests of statistical significance should be applied.
Control group in which the program is to be withheld or a placebo given.
Placebo
Measurement or observation in accordance with criteria adapted in step 2.

FIGURE 2.

A flow chart to illustrate optimum principles and sequence to be followed in conducting a valid experimental design to evaluate a health program.

groups, an experimental one and a control element. This group allocation must follow a scheme of randomization. A system of odd-even assignment subsequent to a plan whereby the experimental units have been ordered is not necessarily a random plan. As pointed out by many investigators Barbacki and Fisher (1), Yates (6), Greenberg (5) a systematic allocation is inefficient and may be highly biased. If matching of the two groups is attempted, either by pairing or balancing the average values of variables in the groups, a random element is still necessary in the allocation procedure, Cochran (2).

Controls are used when relatively little is known about the effectiveness of the program. That is, controls are necessary if the purpose of the evaluation is to find out *if* the program is effective or to measure *how* effective it is.

After the sampled population has been divided into the respective groups, the program under evaluation is brought to bear upon the experimental group in the form of a stimulus. If the evaluation is to be perfectly valid, the control or comparison group should have a placebo applied to it which, insofar as is possible, duplicates with one exception the program or treatment under evaluation.

If possible, all experimental units in both groups should be kept unaware that a special test is being conducted. If this is not done, a type of artificial motivation not ordinarily present in the target population is created. If concealment is not feasible, a compromise should be reached whereby the individuals in both groups do not know to which group they belong. Furthermore, it would also be desirable, whenever possible, to conceal from the persons administering the therapeutic program the identification of the two groups.

Measurements for the two groups are made in accordance with the criteria and at the time agreed upon in the previous step. Comparisons are drawn, and if differences are observed, they are ascribed to the differences in treat-

ment. If the sampled population represents a group of persons smaller in number than the target population, then differences between the two study groups might have arisen because of sampling fluctuations. Tests of statistical significance are usually available to rule out or measure this possibility.

Research workers often use tests of significance for errors of observation other than those caused by sampling variations. This is inappropriate and leads to too many significant results since the remaining errors, such as incomplete registration of events, are frequently much greater in size than that of the sampling error.

It should be reiterated that the previously described procedure is an optimal one to strive for in evaluation. To be realistic, deviations and compromises will have to be made in individual applications because of considerations of time, cost, and facilities as well as the many human factors involved in program evaluation.

Programs to be Evaluated

Finally, the question arises whether *every* program in the health department should be evaluated periodically. Definitely not to the extent discussed in this paper! For example, penicillin need not be evaluated as therapy for syphilis every time it is so used. Before a therapeutic program is universally adapted, however, it should have at least one thorough evaluation as outlined herein. Additional evaluations would be desirable to check the accuracy and precision of the conclusions, as well as to find out what modifications occur as the target population changes.

Referring to the example of penicillin and syphilis again, although an intensive evaluation may not be indicated for each application, routine follow-ups are practiced by competent physicians to ascertain the effectiveness on a particular individual. Any physician who failed to obtain at least a post-treatment serological test would subject himself to severe criticism. Similarly, routine check-ups of all health department programs would be a healthy practice even when those services are approved and accredited in other areas.

There is no standard procedure to recommend for these routine check-ups. One might inquire to see if the original diagnosis or condition has undergone change, if lower intermediate goals are being achieved, if the recipients of the program are aware of the program or in favor of it, and a whole host of substitute "rough and ready " measures.

Summary

Evaluation of public health programs should denote a measurement of the effectiveness of the program. This effectiveness should be measured in terms of the fulfillment of the program's objectives. Procedures for measuring the degree of fulfillment are summarized in the paper.

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THE FUNCTIONS OF THE MEDICAL OFFICER OF HEALTH

AT the request of The Society of Medical Officers of Health of Great Britain, Sir Allen Daley prepared for publication by the Society, a comprehensive statement of the work of the Medical Officer of Health. This has been published in a booklet of forty-six pages. Sir Allen Daley, whose work in public health in Great Britain is known widely on this continent, has made a valuable contribution in reviewing the work of the Medical Officers of Health in the light of the six years in which the National Health Services and National Assistance Acts have been in force. During this time there has been increased attention paid to the amount of sickness among the people and the increasingly heavy cost of remedial measures.

The presentation is concerned primarily with the contribution that the Medical Officer of Health makes, if given the opportunity, to improve the health of the community. Part I develops the theme that the Medical Officer of Health should be the guardian of the community health and decries the present tendency to deal with it in sections rather than as a unit. The services for which the Medical Officer of Health should be executively responsible are set out in Part II. These are presented under the headings, Environmental Health Services including Epidemiology, Personal Health Services which are of general application such as Health Education and Health Centres and of services which apply to special groups including care of the mother and child, school children and the care of the aged, the handicapped and other special groups. A few of the main controversial points in each of the services are discussed with the object of defining the boundaries of the community health service.

Part III emphasizes the need for the Medical Officer of Health to be placed in a position where he may advise on the medical aspects of other services, of which he need not be in executive control, where this affects the community health. In the concluding section he emphasizes the general duty of studying all matters affecting the health of his area.

This outline of the functions of the Medical Officers of Health by this eminent authority will be read with interest by all who are following the development of public health in Great Britain. The publication by The Society of Medical Officers of Health will do much to correct current misimpressions of the status of the Medical Officer of Health. The offices of the Society are in Tavistock Square, London, W.C.1.

NEWS

MUCH OF THE SURGICAL WORK in Cleft Lip and Cleft Palate cases in Ontario has been carried out for many years in The Hospital for Sick Children, Toronto. It has been recently announced that this work will be expanded with the assistance of a generous Grant from the Atkinson Charitable Foundation. A Cleft Palate Research and Treatment Centre was opened in the Hospital early this year and already approximately one hundred children have been examined.

The purpose of the Clinic is to arrange for a detailed examination of children with this deformity who have reached four or five years of age. The examination will be made by a plastic surgeon, an orthodontist, a paediatrician, and a speech therapist. Results of this examination will be of considerable assistance in regard to future treatment of this deformity. No charge will be made for the initial examination. Should speech therapy, orthodontia, or other treatment be found necessary, this will be arranged with the parents according to their ability to pay.

Physicians who know of children with this deformity are invited to co-operate by arranging an appointment with Dr. A. J. Rhodes, Director, The Research Institute, The Hospital for Sick Children, 555 University Avenue, Toronto.

With the great increase in the number of births in Ontario in the last few years, there will be an increasing number of children with Cleft Lip and Cleft Palate requiring medical and surgical care. It is evident, therefore, that research in this condition, particularly with a view to devising improved methods of treatment, is urgently needed.

British Columbia

DR. WILLIAM BRUCE LAING, a graduate of St. Andrews University in Scotland has been appointed Director of the Skeena Health Unit, Prince Rupert.

DR. DANIEL D. MCGRATH has been appointed Assistant Health Officer at Duncan, in the Central Vancouver Island Health Unit.

DR. JOHN M. CONCHIE has been appointed as a Dental Officer, and is presently working in several of the northern Health Units as far as Dawson Creek in the Peace River Health Unit.

MR. NORMAN GOODE public health engineer with the Division of Public Health Engineering has resigned to accept a position as assistant municipal engineer in the Municipality of Burnaby.

MR. FRANCIS NEATE, a civil engineer, has recently joined the Division of Public Health Engineering, Health Branch, Department of Health and Welfare in Victoria.

Saskatchewan

THE NEW $8,000,000 Saskatchewan Training School for the mentally retarded, which was opened in Moose Jaw on May 18, is one of the most modern institutions of its kind on this continent. Since its establishment in November 1945, the Training School has been housed in temporary quarters at the Weyburn Airport. The new buildings are located on a 800-acre site one mile south of Moose Jaw. The School comprises 30 buildings including 6 staff houses. A one-mile network of tunnels and service passageways provide easy access to distant buildings in bad weather. The School is designed on a cottage plan with each of the 18 cottages bearing a name reminiscent of the Canadian scene. These are divided into two areas, Parkview for the more active patients and Riverview for the more severely retarded. At the present time, the School will accommodate approximately 1,100 patients which include adults and children of all ages. The medical superintendent Dr. A. G. Beddie, who has been at the School since 1951, was formerly deputy medical superintendent of Calderstones in Lancashire, England.

THE SECOND teaching hospital in Canada to be situated on a university campus, the University Hospital at Saskatoon, was formally opened on May 15 by Saskatchewan's Minister of Public Health, the Honorable T. J. Bentley. Construction of the 523-bed hospital costing over $10,000,000, was begun in 1948. The hospital will enable the medical school to give clinical training to students. Previously, such students had to complete their clinical years of training at other universities and often failed to return to the province. Dr. Arnold L. Swanson, formerly executive secretary of the Canadian Hospital Association, is the executive director. The

opening ceremony followed a special convocation of the University of Saskatchewan earlier the same day at which honorary LL.D. degrees were conferred on seven distinguished workers in the health professions. They are: G. H. Agnew, M.D., F.A.C.P., F.A.C.H.A., professor of hospital administration, School of Hygiene, University of Toronto; E. J. Baldes, A.M., Ph.D., Mayo Clinic, Rochester; R. D. Defries, C.B.E., M.D., D.P.H., F.A.P.H.A., director of the School of Hygiene, University of Toronto and of The Connaught Medical Research Laboratories; Kathleen W. Ellis, B.Sc., Reg.N., formerly professor of nursing at the University of Saskatchewan; W. S. Lindsay, O.B.E., B.A., M.B., Ch.B., Dean Emeritus College of Medicine, University of Saskatchewan; F. D. Mott, B.A., M.D., C.M., F.A.P.H.A., D.A.B., medical administrator, Memorial Hospital Association of Kentucky; and J. B. Ritchie, B.A., M.D., M.R.C.S., L.R.C.P., F.A.C.S., Regina physician and surgeon. The convocation address on "The Functional Role of the Hospital" was given by Dr. G. H. Agnew.

Manitoba

THE ANNUAL INSTITUTE of Medical Directors was held from June 1 to 3 at the provincial health building, 320 Sherbrook St. The program included speeches by Winnipeg physicians, surgeons and government personnel; discussion groups and visits to the Children's and Selkirk Mental Hospitals.

DR. RONALD MARTIN has joined the provincial staff as bacteriologist with the Brandon Mental hospital. A native of Australia, Dr. Martin received his B.Sc. degree at the University of Technology in New South Wales, a certificate in bacteriology at the London School of Hygiene and Tropical Medicine, London, England, and his Ph.D. at Giessen, Germany. Prior to coming to Canada, Dr. Martin was bacteriologist in health laboratories in Tanworth and Sydney, Australia.

DR. JAMES T. LUNN has been appointed new Medical Director of the Brandon Health Unit. A graduate of Belfast University, N. Ireland, Dr. Lunn has spent the past two years of his medical career in Newfoundland. Before assuming his post with the Brandon Health Unit, Dr. Lunn was stationed for two months with the Virden Health Unit.

Ontario

THE ONTARIO DEPARTMENT OF HEALTH has announced the appointment of Dr. Norman W. Roome, B.A., M.Sc.(Med.) to its Division of Maternal and Child Hygiene. Before accepting his new post Dr. Roome was Urologist-in-Chief, Toronto Western Hospital. He was formerly instructor in surgery at the University of Chicago, and instructor in both surgery and pharmacology at the University of Western Ontario. Dr. Roome is filling the post vacated by Dr. E. R. Westman who resigned to accept a position with the New York State Department of Health, Watertown, New York.

New Brunswick - Prince Edward Island

THE THIRD ANNUAL MEETING of the New Brunswick–Prince Edward Island Branch of the Canadian Public Health Association was held in Charlottetown on May 19 and 20.

The business session was under the chairmanship of the Vice-President, Mr. A. Cameron. Greetings were given by the Minister of Health for Prince Edward Island, The Honorable Earle MacDonald, by the Minister for New Brunswick, The Honorable J. F. MacInerney, M.D., and the Deputy Minister for Nova Scotia, Dr. Robertson. The President of the Atlantic Branch, Miss P. Lyttle also extended greetings.

Following the business session, Dr. Harold Shaw moderated a panel discussion entitled "Should Voluntary Pre-payment Plans for Medical Care make provision for Preventive Medicine?"

MR. ALWYN CAMERON was named president for the coming term.

Nova Scotia

THE FOLLOWING NURSES have completed a course in Public Health at Dalhousie University, and joined our staff on June 1:

Miss Evelyn Carpenter, of New Waterford to Margaree; Miss Mary Coco of New Waterford to Neil's Harbour; Miss Thelma Stewart of Sydney to Kentville; Miss Claire Garrett of New Glasgow to Baddeck; Miss Joan Ryan, Mulgrave, to Shubenacadie; Miss Mary Ann Pugsley of West Brook, Annapolis Royal; Miss Katherine Weir of New Glasgow to Pictou; Miss Yvonne Theriault of Digby to Yarmouth; Miss Phyllis Dickie of Meaghers Grant to Liverpool; Miss Mary Louise Smith of Windsor, to Bridgewater; Miss Cecile Amirault of Centre East Pubnico to St. Peters.

Also the following nurses are joining our staff for a period of in-service training before going to Dalhousie University in the fall. Miss Patrica MacLeod, Miss Eleanor Graham and Miss Evelyn MacKay.